

REVISION OF THE GENUS *COCCUS* LINN. IN INDIA (INSECTA : HOMOPTERA : COCCIDAE)¹

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(With nine text-figures)

An account of 17 Indian species of the genus *Coccus* Linn. is given. Eight species are redescribed and illustrated in detail. A key to Indian species of the genus *Coccus* is also given.

Genus *Coccus* Linn.

Type-species: *Coccus hesperidum* Linn., 1758, subsequent designation by Danzig and Kerzhner, 1981.

Coccus, the oldest genus in the Coccoidea, was proposed by Linn. in 1758 with several species of which *Coccus hesperidum* Linn. was generally accepted as its type. Many nomenclatural and taxonomic problems exist within this genus since its type *Coccus hesperidum* Linn. has never been designated properly (Gill *et al.* 1977). However, most of the authors followed Fernald (1903) in recognising *C. hesperidum* Linn. as its type-species. This also serves as the type for the genus *Lecanium* Burmeister. Williams and Kosztarab (1972) were of the opinion that since *C. hesperidum* is universally accepted as the type of *Coccus*, the genus *Lecanium* Burmeister should have a new type designation.

This problem of duplicity of type has been recently resolved by the International Commission on Zoological Nomenclature by rejecting and invalidating *Lecanium* Burmeister, 1835 (a junior objective synonym of *Coccus* Linn., 1758) and making official the genus *Coccus* Linn. with type-species *Coccus hesperidum* Linn. (Danzig and Kerzhner 1981).

No comprehensive systematic study of the Indian species of *Coccus* is available. The species listed by various authors from the Indian region contain only locality records, host plants records and occasionally biological information and field identification characters which are insufficient for

the identity of a species. However, some of these species were fully redescribed by recent coccidologists whereas descriptions of others are still inadequate.

At present the genus is known to contain 17 species from India of which eight are redescribed and illustrated in detail. For the others, which are not fully treated here, the references for their redescription, illustrations and taxonomic notes if any, are given. A key for the separation of Indian species of *Coccus* and the distribution of the species in Indian regions are also given. All measurements are in millimetres. If there is any variation in the measurements, minimum and maximum limits found in the specimens are given as well. The material examined for study were from British Museum (Natural History), London (BMNH) and National Museum of Natural History, Washington D.C. (NMNH). Other material collected by us for study is deposited in Zoological Museum, Aligarh Muslim University, Aligarh (ZMAMU).

KEY TO INDIAN SPECIES OF *Coccus* LINN., BASED ON ADULT FEMALES

1. Tubular ducts absent on venter.....2
Tubular ducts present on venter4
2. Legs well developed with tibia and tarsus distinctly separated; antennae 7-8-segmented; body oval, elongate oval, not pointed at extremities 3
- Legs greatly reduced, with tibia and tarsus fused together; antennae 3-segmented, sometimes with membranous division indicating 5 segments; body slender, pointed at extremities (Zimmerman 1948: Fig. 155; Gill *et al.* 1977 : Fig. 3)
.....*C. acutissimus* (Green)
3. Dorsal setae curved and apically pointed; paraopercular pores present; a few marginal setae bifurcated or fimbriate; antennae 8-segmented (Ben-Dov 1977: Fig. 1; Gill *et al.* 1977 : Fig 6) *C. longulus* (Douglas)

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KEY TO INDIAN SPECIES OF *Coccus* LINN. (CONTD.)

- Dorsal setae cylindrical and straight; paraopercular pores absent; marginal setae simple; antennae 7-segmented, sometimes with membranous division on 4th segment indicating 8 segments (Fig. 8 ... *C. ophiorrhizae* (Green)
- 4. Anal plates together oval with cephalolateral and caudolateral margins fused together to form a continuous curve 5
- Anal plates together roughly quadrate with cephalolateral and caudolateral margins forming a distinct lateral angle 7
- 5. Stigmatic clefts each with 3 spines 6
- Stigmatic clefts each with about 20 or more spines (Fig. 1; De Lotto 1959: Fig. 1)... *C. adersi* (Newstead)
- 6. Marginal setae bifid and fimbriate (Fig. 2; De Lotto 1957: Fig. 2) *C. bicruciatu*s (Green)
- Marginal setae simple (Rao and Kumar 1952: Fig. 14) *C. watt*i (Green)
- 7. Anal plates each with 3-5 small setae dorsally 8
- Anal plates each with about 15 small setae dorsally (Avasthi and Shafee 1983: Fig. 2) *C. kosztarabi* Avasthi and Shafee
- 8. Dorsal setae cylindrical, with or without swollen apices 9
- Dorsal setae spine-like or slendrical with pointed apices 13
- 9. Antennae less than 8-segmented; tubular ducts absent on submarginal areas on dorsum 10
- Antennae 8-segmented; tubular ducts present on submarginal areas on dorsum (Fig. 5; Ben-Dov 1981: Fig. 2) *C. gymnospori* (Green)
- 10. Submarginal tubercles present; dorsal setae slightly swollen apically 11
- Submarginal tubercles absent; dorsal setae never swollen apically (Fig. 7) *C. latioperculatum* (Green)
- 11. Ventral thoracic tubular ducts present 12
- Ventral thoracic tubular ducts absent (Gill *et al.* 1977: Fig. 4) *C. capparidis* (Green)
- 12. Antennae 7-segmented; tibio-tarsal articulatory sclerosis present (Fig. 9; Zimmerman 1948: Fig. 161; De Lotto 1960: Fig. 5; Gill *et al.* 1977: Fig. 10) *C. viridis* (Green)
- Antennae 4-5-segmented; tibio-tarsal articulatory sclerosis absent (Fig. 3) *C. colemani* Kannan
- 13. Paraopercular pores present 14
- Paraopercular pores absent 15
- 14. Tubular ducts few, always present in mid-thoracic region, often between forelegs and rostrum: dorsal setae spinose with finely or bluntly pointed apices, distinctly differs from marginal setae (Fig. 6; De Lotto 1959: Fig. 4; Hodgson 1967: Fig. 1; Williams and Kosztarab 1972: pl. 7; Gill *et al.* 1977: Fig. 5) *C. hesperidum* (Linn.)

Tubular ducts numerous, confined to medio-submedian regions of head and thorax; dorsal setae slendrical with pointed apices, similar to marginal setae (Takagi 1975: Fig. 1) *C. formicarii* (Green)

- 15. Tibio-tarsal articulatory sclerosis present; dorsal setae large, strongly spinose (Fig. 4) *C. discrepans* (Green)
- Tibio-tarsal articulatory sclerosis absent; dorsal setae small, spine-like with finely or bluntly pointed apices (Avasthi and Shafee 1983: Fig. 1) *C. almoraensis* Avasthi and Shafee

***Coccus acutissimus* (Green)**

Lecanium acutissimum Green 1896: 10; Ayyar 1930: 48.

Coccus acutissimus (Green): Fernald 1903: 168; Fletcher 1919: 293; Ferris in Zimmerman 1948: 295; Takahashi 1952: 15; Ali 1971: 21; Varshney 1985: 26.

The general appearance of the species as given in the original description is: "Very narrow, pointed in front and behind, of the shape and size of a carroway seed. Reddish brown to black" (Green 1896). Further, he mentioned that in this species antenna is 6-jointed and there is a single stigmatic spine. Gill *et al.* (1977) studied the syntype and found reduced antennae, 161-198 μ long, 3-segmented, sometimes with membranous divisions indicating 5 segments and 3 stigmatic spines. Further, they redescribed and illustrated this species in detail and mention its occurrence in India as well. They were of the opinion that it is not congeneric and the distinctive slender body with pointed extremities, dark coloration of older specimens and reduced appendages easily distinguish this species from other *Coccus* species in the New World.

Distribution: Tamil Nadu: Coimbatore.

***Coccus adersi* (Newstead) (Fig. 1)**

Lecanium adersi Newstead 1917: 357; Ayyar 1930: 47.

Coccus adersi (Newstead): De Lotto 1959: 155; Ali 1971: 21; Varshney 1985: 26.

Adult female (Fig. 1 A): Mounted specimens irregularly ovate, 4.59-6.12 mm long, 3.23-3.4 mm wide. Dorsum with a few small oval or circular translucent areas on submedian regions of

abdomen. Setae (Fig. 1 B) minute, spiniform and evenly distributed. Para-opercular pores and submarginal tubercles absent. Tubular ducts (Fig. 1 C) few, present in a fairly regular series on submargins of the body. Anal plates (Fig. 1 D) together oval, with cephalolateral and caudolateral margins fused together to form a continuous curve; each plate with three apical and four subapical setae; anal fold with two pairs of small fringe setae. Marginal setae (Fig. 1 E) small, curved, dilated apically and set very close to each other, 33-43 setae between anterior and posterior stigmatic clefts. Stigmatic clefts well developed, each with 18-24 cylindrical setae of variable lengths and diameter (Fig. 1 F).

Venter with thin spinose setae (Fig. 1 G) arranged submarginally and a few scattered irregularly on median region. Inter-antennal and prevulvular setae 2 pairs each. Quinquelocular pores (Fig. 1 I) few, near cleft and spiracular opening but not in a continuous row. Multilocular pores absent. Tubular ducts (Fig. 1 H) few, near genital opening only. Eyes absent. Antennae 7-segmented (Fig. 1 J) but sometimes 6-segmented (Fig. 1 K), with a pseudo-articulation on third segment, 0.4-0.44 mm long. Spiracles normal. Legs well developed, without tibio-tarsal articulatory sclerosis; claws simple, digitules longer than claw and clubbed apically (Fig. 1 L); dimensions of fore, mid and hind legs: trochanter + femur (0.24 - 0.25: 0.25-0.27: 0.28-0.29 mm), tibia (0.15-0.16: 0.16-0.18: 0.18-0.19 mm) and tarsus (0.11: 0.12: 0.12 mm) respectively.

Material examined: 1 slide with 2 adult females, labelled: *Lecanium adersi* Newstead, from Mango, Zanzibar, 1913, R. Newstead (BMNH).

This species seems not to be congeneric and differs from all known species of *Coccus* by its having numerous stigmatic spines. Further, the presence of oval anal plates, shows its close relationship with *C. bicruciatatus* (Green).

Distribution: Tamil Nadu: Coimbatore.

Coccus almoraensis Avasthi & Shafee

Coccus almoraensis Avasthi and Shafee 1983 : 389, 1988: 43.

Material examined: Holotype female, Paratypes 3 females. INDIA: Uttar Pradesh, Almora, on wild plant, 7 June 1978; 5 females paratypes, Bihar, Arrah, on *Mangifera indica* L., 12 November 1979 (R.K. Avasthi) (ZMAMU).

Distribution: Uttar Pradesh: Almora; Bihar: Arrah.

Coccus bicruciatatus (Green) (Fig. 2)

Lecanium bicruciatum Green 1904 214 Ayyar 1930: 50.

Coccus bicruciatatus (Green): Green 1904:248; Ferris 1921: 212; De Lotto 1957 : 299; Ali 1971 : 22; Varshney 1985 : 26.

Adult female (Fig. 2 A): Mounted specimens more or less oval, 3.23-5.61 mm long; 2.14-3.81 mm wide. Dorsum with some irregular shaped pale areas on submedian areas of postsoma, each with a variable number of pores (Fig. 2 C). Setae (Fig. 2 B) minute and spiniform. Para-opercular pores and submarginal tubercles absent. Anal plates (Fig. 2 E) together oval, with cephalolateral and caudolateral margins fused together to form a continuous curve; each plate with three apical and one subapical setae; anal fold with two pairs of small fringe setae. Marginal setae (Fig. 2 F) small, curved, bifid, fimbriate apically and set close to each other, 20-35 setae between anterior and posterior stigmatic clefts. Stigmatic clefts well developed each with a large deeply chitinized rim and three spines, median spine about as equal as or 1.5 times longer than laterals (Fig. 2 D).

Venter with thin spinose setae (Fig. 2 G) arranged irregularly. Inter-antennal and prevulvular setae 1-2 and 2-3 pairs respectively. Quinquelocular pores (Fig. 2 I) in a row between spiracles and stigmatic clefts. Multilocular pores absent. Tubular ducts (Fig. 2 H) few around genital opening only. Eyes absent. Antennae (Fig. 2 J, K) 6-7-segmented, 0.35-0.39 mm long. Spiracles normal. Legs well developed, without tibiotarsal articulatory sclerosis; claws simple, digitules longer than claw and flattened apically; tarsal digitules long, slender and clubbed at apices (Fig. 2 L); dimensions of fore, mid and hind legs: trochanter + femur (0.22-0.23: 0.23-0.25: 0.24-

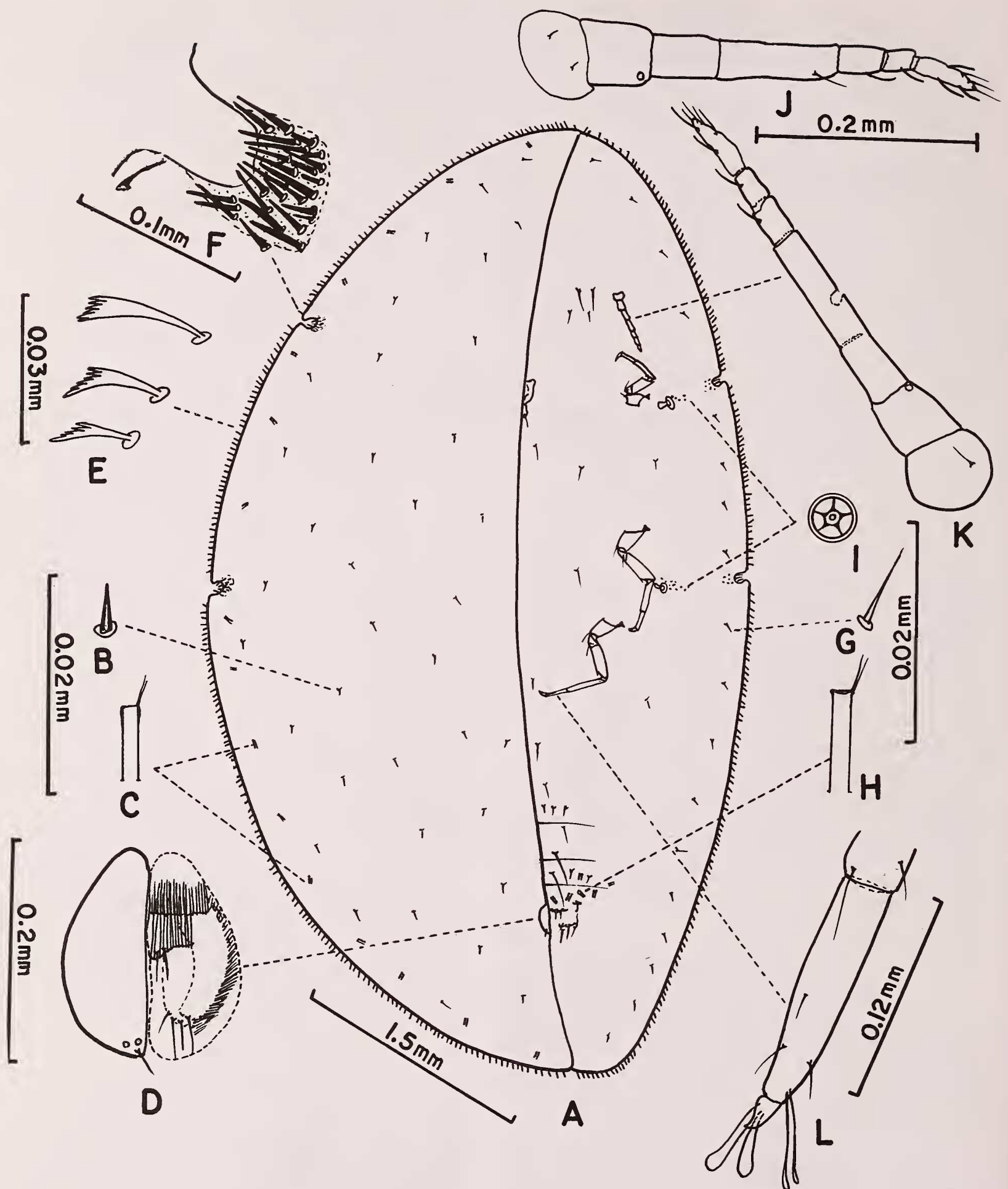


Fig. 1. *Coccus adersi* (Newstead), female. See text for explanations.

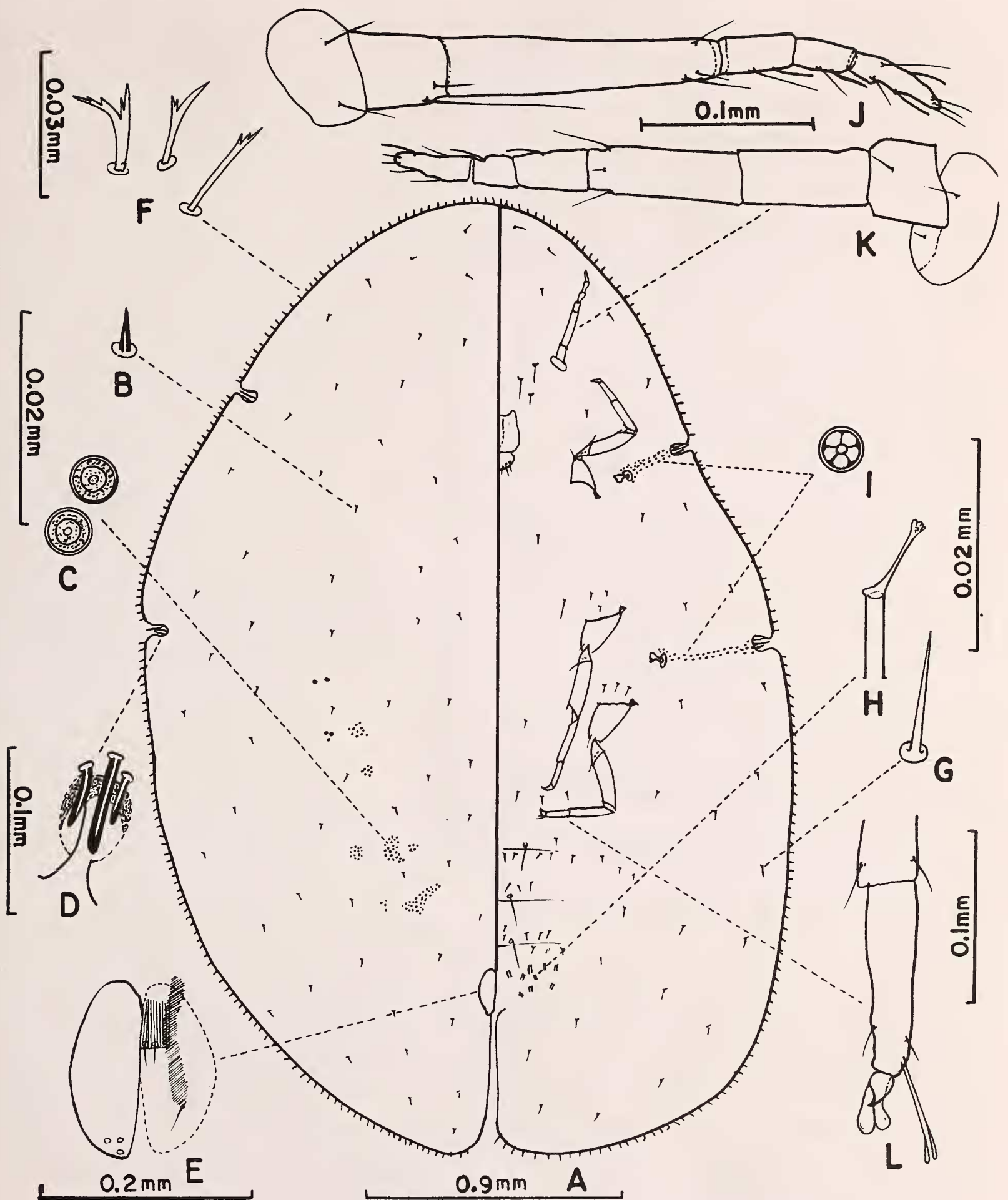


Fig. 2. *Coccus bicruciatatus* (Green), female. See text for explanations.

0.27 mm), tibia (0.12-0.13 : 0.14-0.15 : 0.15 mm) and tarsus (0.1-0.11 : 0.11-0.12 : 0.11-0.12 mm) respectively.

Material examined: 1 slide with 3 adult females, labelled: *Coccus bicruciata* (Green), on *Crpporis mitohrili*, Aug. 12, 1931; Chinrhilla. (NMNH).

The presence of oval shaped anal plates shows its close resemblance with *C. adersi* and easily distinguishes it from other *Coccus* species.

Distribution: Tamil Nadu: Tirunelveli.

Coccus capparidis (Green)

Lecanium capparidis Green 1904 : 187.

Lecanium (Coccus) capparidis Green 1937 : 299.

Coccus capparidis (Green) Green 1904: 248; Ali 1971 : 22; Gill *et al.* 1977 : 16; Varshney 1985 : 26.

Gill *et al.* (1977) redescribed and illustrated this species in detail and were of the opinion that "*C. capparidis* apparently belongs with the groups of species centered around *C. hesperidum*"

Distribution: West Bengal: Darjeeling.

Coccus colemani Kannan (Fig. 3)

Coccus colemani Kannan, 1918: 135; Green 1918: 149; Ali 1971: 23.

Coccus viridis var. *colemani* Kannan: Puttarudriah and Channabasavanna 1953: 252; Varshney 1985 : 26.

Lecanium (Coccus) colemani Kannan: Ayyar 1930 : 49.

Adult female (Fig. 3A): Mounted specimens oval, 1.84-2.55 mm long, 1.12-1.53 mm wide. Dorsum with small slightly oval pale areas (Fig. 3 F). Setae (Fig. 3 B) cylindrical, slightly swollen apically and scattered irregularly. Para-opercular pores generally absent; sometimes 2-3 pores (Fig. 3 D) present anterior to anal plates. Submarginal tubercles (Fig. 3 C) 6-10 in number. Anal plates (Fig. 3 E) together quadrate with cephalolateral margins distinctly shorter than caudolateral margins, each plate with three apical and two subapical setae; anal fold with two pairs of long fringe setae. Marginal setae (Fig. 3 G) small, fimbriate, few bifid apically; 9-11 setae between anterior

and posterior stigmatic clefts. Stigmatic clefts well developed, each with three spines; median spine long, curved about 2.5 times longer than laterals (Fig. 3 H, I).

Venter with thin spinose setae (Fig. 3 J) arranged submarginally and scattered irregularly on median and submedian areas. Inter-antennal and prevulvular setae 2 and 3 pairs respectively. Quinquelocular pores (Fig. 3 L) few, 18-25 in number, arranged in a row between spiracles and stigmatic clefts. Multilocular pores (Fig. 3 M) few near genital region and extend upto preceding six abdominal segments and decrease in number. Tubular ducts (Fig. 3 K) in mid-thoracic region and a few near genital region. Eyes absent. Antennae (Fig. 3 N) 4-5-segmented, 0.23-0.25 mm long. Spiracles normal. Legs well developed, almost subequal, without tibio-tarsal articulatory sclerosis; tibia and tarsus fused together, sometimes indistinctly separated; claws simple, digitules longer than claw and clubbed apically; tarsal digitules long, slender, clubbed at apices (Fig. 30); dimensions of fore, mid and hind legs: trochanter + femur (0.12-0.14 mm), tibia + tarsus (0.12-0.16 mm).

Material examined: 1 slide with 3 adult females, labelled: *Coccus colemani* Kannan, on *Coffea arabica*, Coffee farm, Balehonnur, Mysore, India, R.H. Le Pley, Col., 29 July 1957. 1 slide with 1 adult female labelled: *Coccus colemani* Kannan, on Vunindawa, Vitileva, Fijii, M.L.H. Krauss Coll. (NMNH).

The general appearance of this species as given in the original description is: "Colour pale yellow to greenish yellow, shape oval, the anterior end being narrower but is liable to variation in specimens fixed on the sides of veins of leaves in which the anterior end is more or less acuminate, and either the right or the left side may be shortened and straight" (Kannan 1918). It was considered a mutant of *C. viridis* by the original author, but Green (1918) remarked "it seems questionable if there is sufficient justification for the erection of this new species." Ali (1971) catalogued it as a distinct species whereas Varshney (1985) listed it as a variety of *C. viridis*.

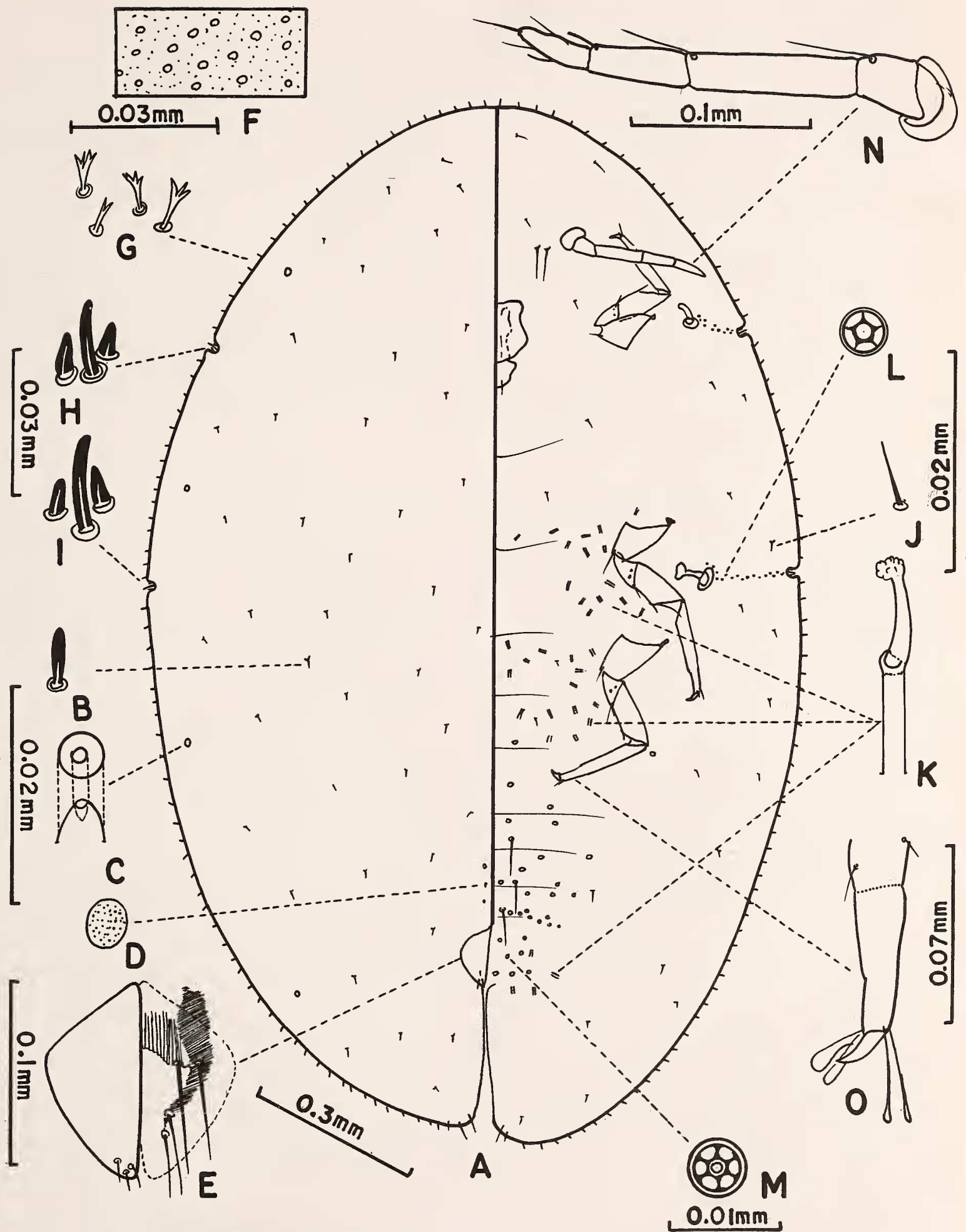


Fig. 3. *Coccus colemani* Kannan, female. See text for explanations.

The study of Indian and Fiji material supports Green (1918) and Ali (1971) in recognising it as a distinct species which differs from *C. viridis* in key characters.

Distribution: Karnataka: Mysore.

***Coccus discrepans* (Green) (Fig. 4)**

Lecanium discrepans Green 1904: 204; Fletcher 1921: 19; Misra 1923: 348; Ayyar 1930: 50.

Coccus discrepans (Green): Morrison 1921: 654; Das & Ganguli 1961: 247; Ali 1971: 23; Varshney 1985: 26.

Saissetia discrepans (Green), 1904: 248.

Adult female (Fig. 4 A): Mounted specimens irregularly oval, 2.38 mm long, 1.69 mm wide. Dorsal setae (Fig. 4 B) large, spinose, scattered irregularly. Para-opercular pores absent. Submarginal tubercles (Fig. 4 C) eight in number. Anal plates (Fig. 4 D) together quadrate with cephalolateral margins about as long as caudolateral margins, each plate with 3 apical and 1 subapical seta; anal fold with 2 pairs of fringe setae. Marginal setae (Fig. 4 E) small, simple, few bifid; a pair of marginal setae on apex of cleft fimbriate; 7-11 setae between anterior and posterior stigmatic clefts. Stigmatic clefts well developed with three spines; median spine broken, but available spines about as long as or twice the length of lateral spines (Fig. 4 F).

Venter with thin setae (Fig. 4 G) sparsely arranged. Inter-antennal and prevulvular setae two and three pairs respectively. Quinquelocular pores (Fig. 4 I) 8-22 in number, arranged in a row one pore wide between stigmatic clefts and spiracles. Multilocular pores (Fig. 4 J) few near genital region and on preceding one or two abdominal segments. Tubular ducts (Fig. 4 H) few near middle coxae and sparse between middle legs. Eyes absent. Antennae (Fig. 4 K) broken, visible up to five segments. Spiracles normal. Legs well developed, with a tibio-tarsal articulatory sclerosis and without free articulation; claws simple, digitules unequal; tarsal digitules long, slender with clubbed apices (Fig. 4 L); dimensions of fore, mid and hind legs: trochanter + femur (0.13: 0.14: 0.14 mm), tibia (0.09: 0.11:

0.1 mm) and tarsus (0.06: 0.07: 0.07 mm) respectively.

Material examined: 1 slide with single adult female, poor in condition, labelled: *Lecanium discrepans* Green, from nest of ants *Cremastogaster dohrni*, on tea plant, Pundaluoya, Ceylon part of type material (NMNH).

Morrison (1921) justified the placement of this species in *Coccus* instead of *Saissetia* as originally listed by the describer of the species. The common red ant *Oecophylla smaragdina* has been found in constant attendance on this species (Das and Ganguli 1961).

Distribution: Assam: Gauhati, Tocklai; Bihar: Pusa; Andhra Pradesh: Godavari; Kerala: Travancore.

***Coccus formicarii* (Green)**

Lecanium formicarii Green 1896: 10; Ayyar 1930: 47; Ferris 1936: 14; Takahashi 1952: 16.

Lecanium globulosum Maskell 1897b: 243; Fernald 1903: 212.

Saissetia formicarii (Green): Fernald 1903: 202; Das and Ganguli 1961: 247; Ali 1971: 44.

Coccus formicarii (Green); Takagi 1975: 33; Varshney 1985: 26.

This interesting form is said to be found enclosed in the nests of ants especially the ant *Cremastogaster dohrni* (Ayyar 1930). In the absence of attendant ants, the coccid disappears (Das and Ganguli 1961). The general appearance of this species as given in the original description is on stems of tea and other shrubs, always sheltered by nests of a small brown ant (*Cremastogaster* sp.). Highly convex, almost globular, dull brown. (Green 1896). Takagi (1975) redescribed and illustrated the species in detail and placed it in *Coccus* instead of *Saissetia*. Further, he doubted that this species was congeneric to *C. hesperidum* L. It is different from all species of *Coccus* in having numerous tubular ducts in medio-submedian regions of the head and thorax.

Distribution: Karnataka: Mysore; plains of north-east India.

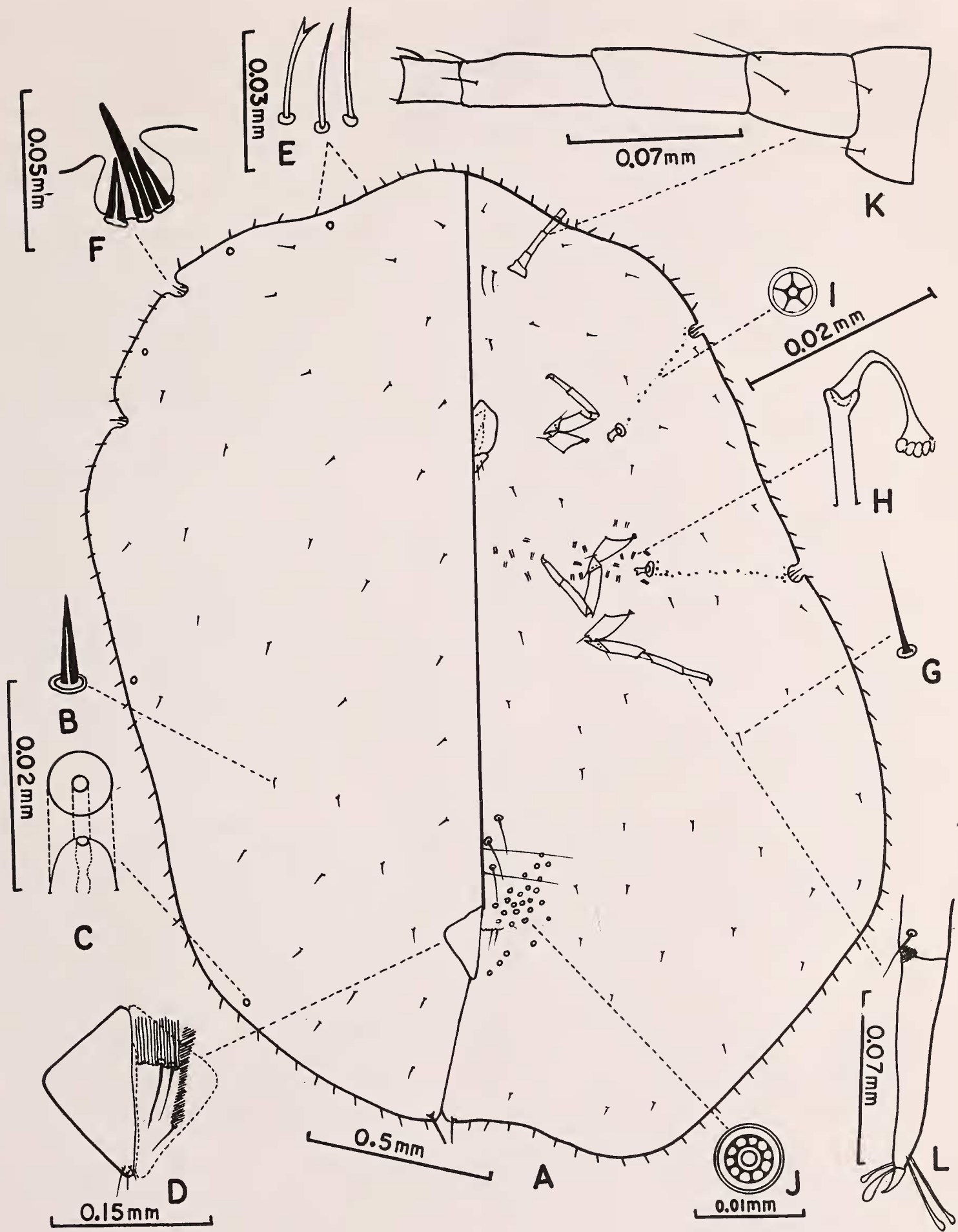


Fig. 4. *Coccus discrepans* (Green), female. See text for explanations.

Coccus gymnospori (Green) (Fig. 5)

Lecanium gymnospori Green 1908: 29; Ayyar 1930: 48.

Coccus gymnospori (Green): Sanders 1909: 45; Ali 1971: 24; Ben-Dov 1981: 651; Varshney 1985: 26.

Adult female (Fig. 5 A): Mounted specimens usually oval, 2.42- 4.59 mm long, 1.56-3.23 mm wide. Dorsum with numerous small circular or oval pale areas (Fig. 5 F). Dorsal setae (Fig. 5 B) cylindrical with slightly narrowing apices. Parapercular pores absent. Submarginal tubercles (Fig. 5 C) 6-11 in number. A few tubular ducts (Fig. 5 N) present towards margin. Anal plates (Fig. 5 M) together quadrate, with cephalolateral margins about as long as caudolateral margins; each plate with four apical (three dorsal, 1 ventral) and three subapical setae; anal fold with two pairs of long fringe setae. Marginal setae (Fig. 5 D) stout, simple, few bifid and fimbriate at apices; 13-23 setae between anterior and posterior stigmatic clefts. Stigmatic clefts well developed, each with three spines; median spine long, almost straight (Fig. 5 E).

Venter with thin spinose setae (Fig. 5 G) arranged towards margin and sparse on median and submedian areas. Inter-antennal and prevulvular setae two and three pairs respectively. Quinquelocular pores in a row between stigmatic clefts and spiracles. Multilocular pores (Fig. 5 J) near genital region and very few on preceding 2 abdominal segments. Tubular ducts (Fig. 5 H) few, present between meso- and metacoxae, in a transverse band between mesocoxae, few ducts in between dorsum and fore coxae. Eyes present. Antennae (Fig. 5 K) 8-segmented, 0.32-0.36 mm long. Spiracles normal. Legs well developed with free tibio-tarsal articulation and well developed articulatory sclerosis; claws simple, digitules longer than claw and clubbed apically; tarsal digitules slender and clubbed apically (Fig. 5 L); dimensions of fore, mid and hind legs: trochanter + femur (0.16-0.2: 0.18-0.2: 0.2-0.23 mm), tibia (0.11-0.12: 0.12-0.15: 0.15-0.16 mm) and tarsus (0.06-0.08: 0.07-0.08: 0.08-0.11 mm) respectively.

Material examined: 1 slide with 4 adult females and 1 immature form labelled: *Coccus gymnospori*, on Cacao, Kandy, Ceylon, Aug. 29, 1954, Dr. D.E. Dardy Coll. 2 slides each with 1 adult female labelled: *Coccus gymnospori* (Green), on *Gymnosporia montana*, Poona, India, Coll. E.E. Green (part of type) (NMNH).

The general appearance of this species as given in the original description is: "Adult female (dried examples), deep ochreous, sometimes mottled with reddish brown. Eyes black. Elongate oval; shrivelled and wrinkled when dry. Trace of an irregular median carina" (Green 1908).

Distribution: Andhra Pradesh: Guntur; Maharashtra: Poona.

Coccus hesperidum Linn. (Fig. 6)

Coccus hesperidum Linn. 1758: 455; Fernald 1903: 168; Zimmerman 1948: 301; Takahashi 1952: 14; Borchsenius 1957: 294; De Lotto 1959: 160; Ghose 1961: 65; Das and Ganguli 1961: 248; Ganguli and Ghose 1964: 358; Boratynsky and Williams 1964: 108; De Lotto 1965: 192; Hodgson 1967: 4; Ali 1971: 24; Williams and Kosztarab 1972: 55; Gill *et al.* 1977: 18; Varshney 1985: 26; Avasthi and Shafee 1988: 43.

Chermes hesperidum (Linn.), Geoffroy 1762: 505.

Calypticus hesperidum (Linn.): Costa 1835: 8.

Calypticus laevis Costa 1835: 11.

Coccus patelliformis Curtis 1843: 517.

Chermes louri Boisduval 1867: 340.

Lecanium angustatum Signoret 1873: 398.

Lecanium maculatum Signoret 1873: 400.

Lecanium hesperidum (Linn.): Burmeister 1835: 69; Newstead 1903: 78; Green 1904: 188, 197, 1908: 30; Misra 1923: 347; Ayyar 1930: 46.

Lecanium alienum Douglas 1886: 77.

Lecanium depressum var. *simulans* Douglas 1887a: 28

Chermes aurantii Alfonso, Targioni-Tozzetti 1891: 10.

Lecanium minimum Newstead 1892: 141.

Lecanium assimile var. *amaryllis* Cockerell 1893a: 53.

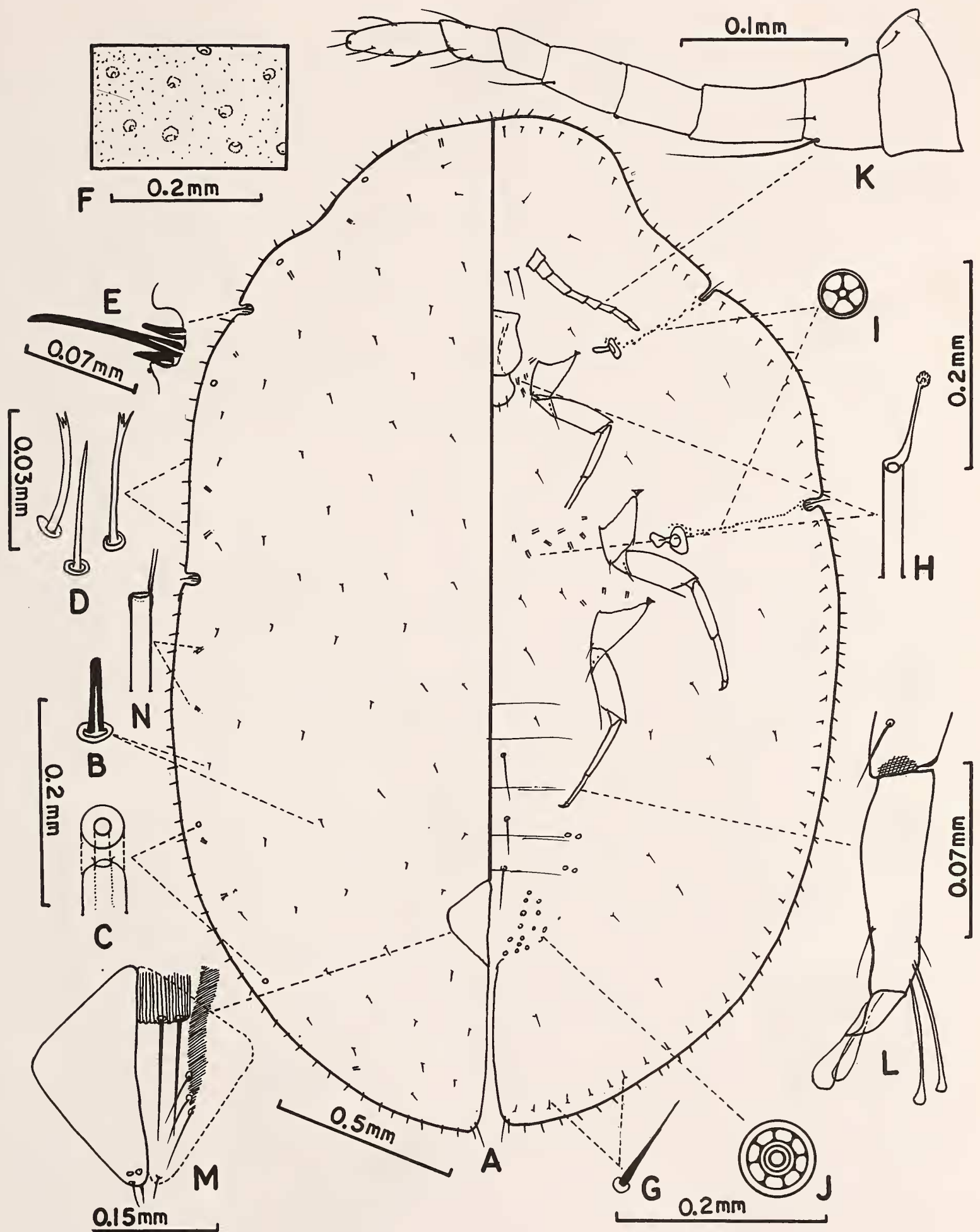


Fig. 5. *Coccus gymnospori* (Green), female. See text for explanations.

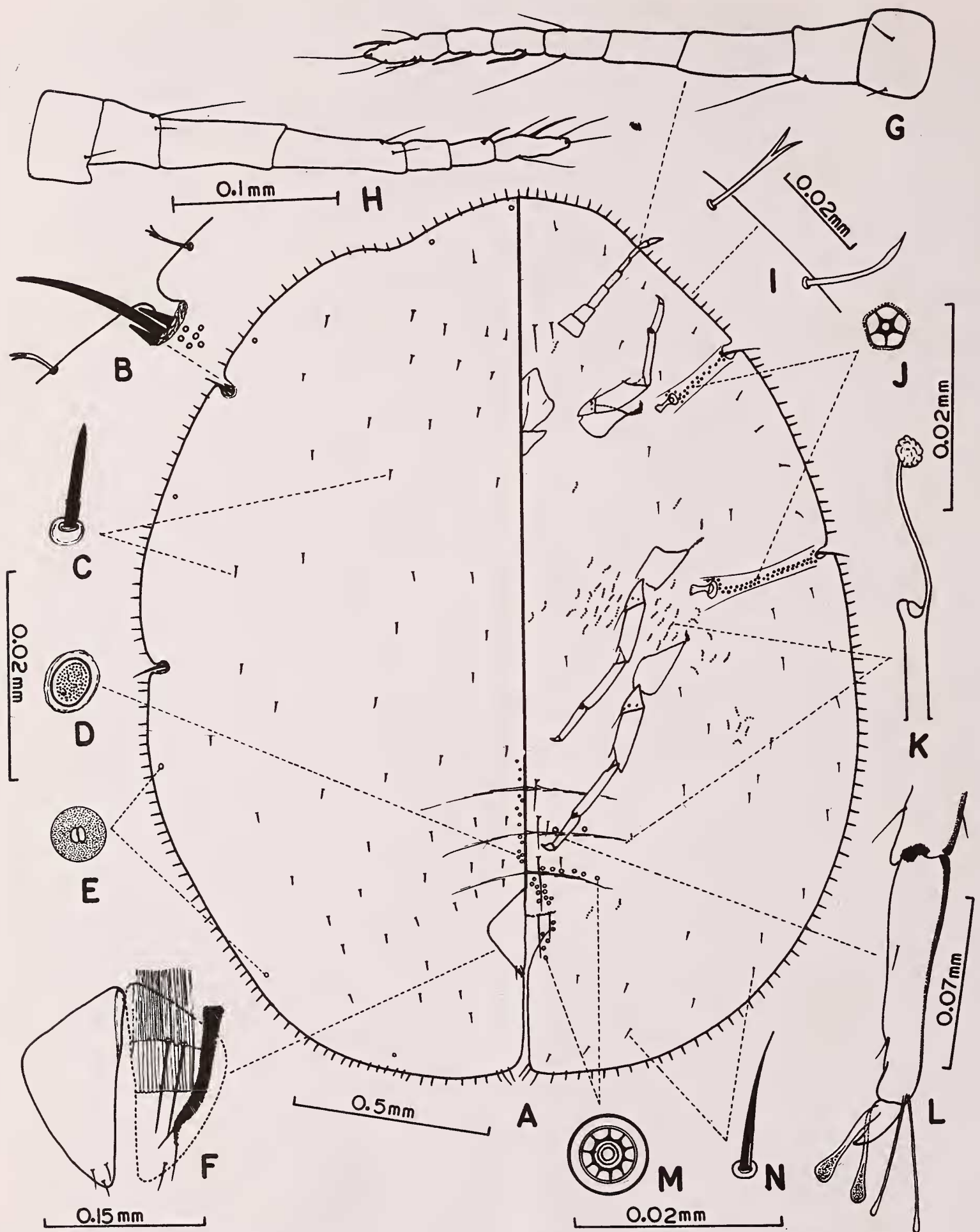


Fig. 6. *Coccus hesperidum* Linn., female. See text for explanations.

Lecanium terminaliae Cockerell 1893b: 254.
Lecanium ceratoniae Gennadius 1895: cclxxvii.
Lecanium nanum Cockerell 1896: 19.
Lecanium flaveolum Cockerell 1897: 52, 53.
Lecanium minimum var. *pinicola* Maskell 1897a: 310.
Lecanium ventrale Ehrhorn 1898: 245.
Lecanium (*Calymnatus*) *hesperidum pacificum* Kuwana 1902: 30.
Lecanium hesperidum var. *minimum* Newstead 1903: 85.
Lecanium signiferum Green 1904: 197.
Lecanium punctuliferum Green 1904: 205.
Lecanium mauritiense Mamet 1936: 96.

The synonyms listed above were obtained from Gill *et al.* (1977).

Material examined: 6 females INDIA: Jammu & Kashmir, Srinagar, on wild plant, 19 June 1977; 3 females, Uttar Pradesh, Aligarh, on *Mangifera indica* L., 25 February 1979; 3 females, Tamil Nadu, Coimbatore, on wild plant, 29 March 1979 (R.K. Avasthi). 3 females, Uttar Pradesh, Aligarh, on *Ficus infectoria* Wild., 13 November 1979 (S.A. Shafee) (ZMAMU).

The detailed redescription and illustration of this species are given by Zimmerman (1948), De Lotto (1959), Hodgson (1967), Williams and Kosztarab (1972), Gill *et al.* (1977). In this species the antenna is 7-segmented, but occasionally 8-segmented. Free tibio-tarsal articulation is generally absent, but observed in some specimens though there is well developed articulatory sclerosis. Occasionally the tubular ducts are also present posterior to hind coxae.

Distribution: Bihar: Pusa; Kerala: South Malabar; Andhra Pradesh: Godavari; Tamil Nadu: Coimbatore; Karnataka: Bangalore; Gujarat: Surat; West Bengal; Goa; Tripura; Jammu & Kashmir: Srinagar; Uttar Pradesh: Aligarh.

Coccus kosztarabi Avasthi & Shafee

Coccus kosztarabi Avasthi & Shafee 1983: 389; 1988: 44.

Material examined: Holotype female, Paratypes 6 females, INDIA: Karnataka, Tumkur, on *Mangifera indica* L., 8 April 1979 (R.K. Avasthi).

(ZMAMU).

This species differs from all Indian species in having numerous setae on dorsum of anal plate. **Distribution:** Karnataka: Tumkur.

Coccus latioperculatum (Green) (Fig. 7)

Lecanium latioperculatum Green 1922: 1022; Ayyar, 1930: 50.

Coccus latioperculatum (Green): Ali 1971: 26; Varshney 1985: 26.

Adult female (Fig. 7 A): Mounted specimens oval in shape, 1.53-1.91 mm long, 0.98-1.39 mm wide. Dorsum with small pale areas (Fig. 7 E). Dorsal setae (Fig. 7 B) cylindrical, scattered irregularly. Para-opercular pores (Fig. 7 C) very few, up to 10 or absent. Submarginal tubercles absent. Anal plates (Fig. 7 D) together roughly quadrate with cephalolateral margins slightly longer than caudolateral margins, each plate with 3 apical and 1 subapical setae; anal fold with 2 pairs of fringe setae. Marginal setae (Fig. 7 F) small, curved, bifid and fimbriate, 4-11 setae between anterior and posterior stigmatic clefts; stigmatic clefts well developed, each with 2-4 spines, generally with 3 (Fig. G-H).

Venter with thin spinose setae (Fig. 7 I) arranged submarginally and scattered irregularly on median and submedian areas. Inter-antennal and prevulvular setae 2 pairs each. Quinquelocular pores (Fig. 7 K) few, 11-15 in number arranged in a row one pore wide between cleft and spiracles. Multilocular pores (Fig. 7 L) few, confined to genital opening only. Tubular ducts (Fig. 7 J) few present near mid coxae, sometimes near rostrum. Eyes absent. Antennae (Fig. 7 M) 7-segmented, 0.22-0.24 mm long. Spiracles normal. Legs well developed with free tibio-tarsal articulation and well developed tibio-tarsal articulatory sclerosis; claws simple, digitules longer than claw and rounded apically; tarsal digitules slender and clubbed at apices (Fig. N); dimensions of fore, mid and hind legs: trochanter + femur (0.11-0.14 : 0.12-0.13: 0.12-0.14 mm), tibia (0.07: 0.07: 0.07 mm), and tarsus (0.04: 0.05: 0.06 mm) respectively.

Material examined: 1 slide with 4 adult females,

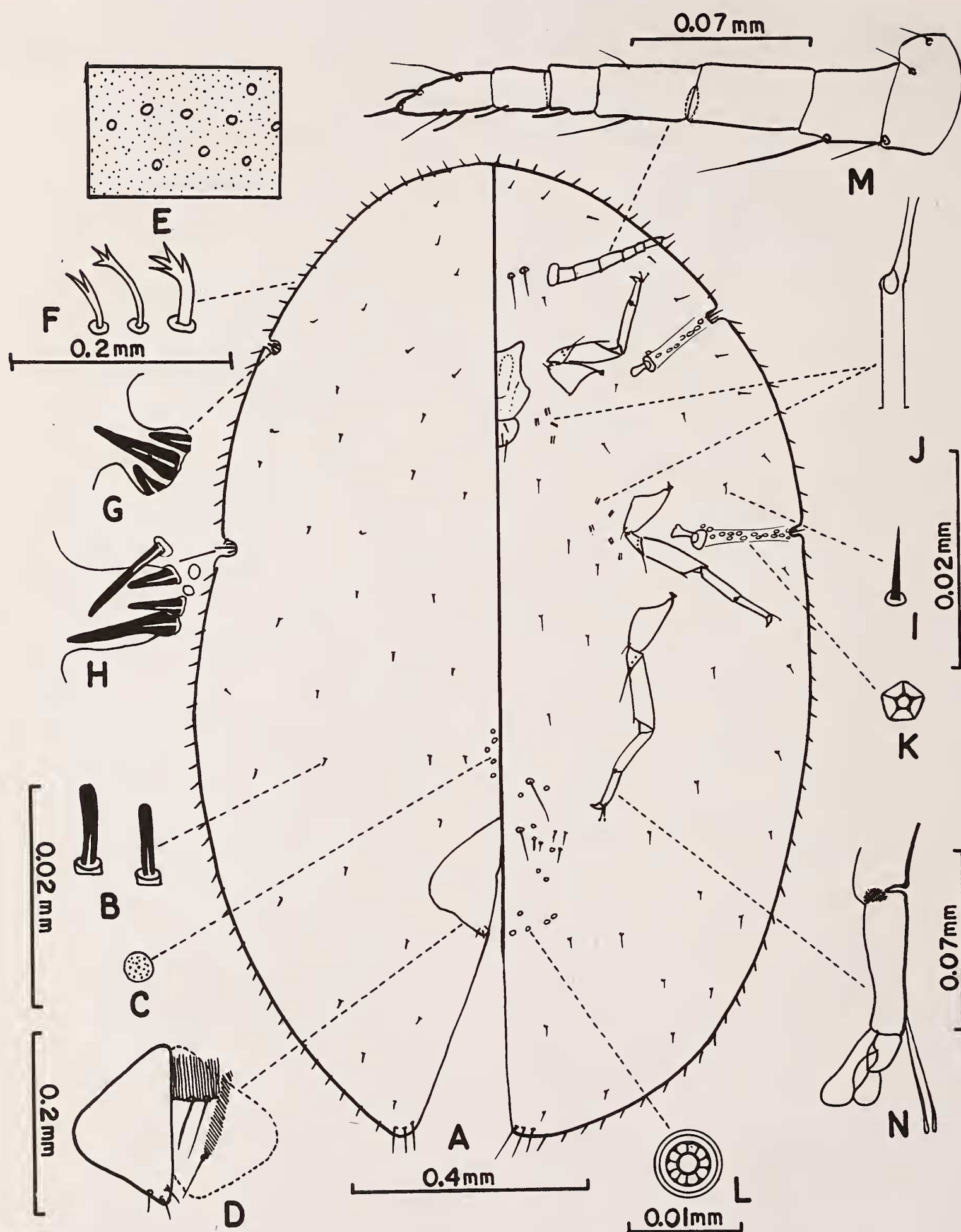


Fig. 7. *Coccus latioferculatum* (Green), female. See text for explanations.

labelled: *Coccus latioperculatus* (Green); *Spondias mangifera*, Matala, Ceylon, Sept. 29, 1954. H.A. Bess. (NMNH).

The general appearance of this species as given in the original description is "Adult female broadly ovate, moderately convex; derm soft, wrinkling when dry; colour yellowish fulvous" (Green 1922).

Distribution: Tamil Nadu: Coimbatore.

***Coccus longulus* (Douglas)**

Lecanium longulum Douglas 1887b: 97; Green 1908: 30; Ayyar 1930: 46.

Lecanium angustatum Signoret: Douglas 1887a: 25 (Misidentification).

Lecanium chirimoliae Maskell 1890: 137; Newstead 1903: 86; Green 1904: 221.

Lecanium ficus Maskell 1897b: 243, Ferris in Zimmerman 1948: 300.

Coccus longulum (Douglas): Kirkaldy 1902: 106.

Coccus longulus (Douglas): Fernald 1903: 171; Green 1904: 248; Ben-Dov 1977: 89; Varshney 1985: 26; Avasthi and Shafee 1988: 44.

Lecanium frontale Green 1904: 192.

Lecanium kraunhiarum Lindinger 1928: 107.

Lecanium wistariae Brain 1920: 8; De Lotto 1957: 301.

Parthenolecanium wistaricola Borchsenius 1957: 349 (as *nom. nov.*); De Lotto 1965: 192.

Lecanium (Coccus) Celtium Kuwana 1909: 162.

Coccus elongatus (Signoret): Zimmerman 1948: 300; De Lotto 1965: 192.

Material examined: 2 females INDIA: Tamil Nadu, Coimbatore, on *Thuja compacta*, 29 March 1979 (R.K. Avasthi) (ZMAMU).

The synonymy of species is taken from Ben-Dov (1977) and Gill *et al.* (1977). Further, they redescribed and illustrated this species in detail. The Indian material resembles in all respects these descriptions and illustrations.

Distribution: Assam: Sonari; Andhra Pradesh: Godavari; Karnataka: Bangalore; Tamil Nadu: Coimbatore.

***Coccus ophiorrhizae* (Green) (Fig. 8)**

Lecanium ophiorrhizae Green 1896: 10; Ayyar

1930: 49.

Coccus ophiorrhizae (Green): Fernald 1903: 173; Green 1904: 248; Ali 1971: 27; Varshney 1985: 26.

Adult female (Fig. 8 A): Mounted specimens elongate elliptical in shape, 2.38 mm long, 1.15 mm wide. Dorsal setae (Fig. 8 B) small, cylindrical, scattered irregularly. Pre-opercular pores absent. Submarginal tubercles (Fig. 8 C) 6 in number, absent in cephalic region. Anal plates together quadrate with cephalolateral margins distinctly shorter than caudolateral margins; each plate with three apical and two subapical setae; anal fold with two pairs of fringe setae. Marginal setae (Fig. 8 E) small, simple, 13 setae between anterior and posterior stigmatic clefts; stigmatic clefts well developed with three spines; median spine long, more than twice the length of lateral spines (Fig. 8 F).

Venter with a few thin spinose setae present on median region of body. Inter-antennal and prevulvular setae two and three pairs respectively. Quinquelocular pores (Fig. 8 G) present in a row between stigmatic clefts and spiracles. Multilocular pores (Fig. 8 H) few around genital opening and on preceding two or three abdominal segments. Tubular ducts absent. Antennae 7-segmented (Fig. 8 I), sometimes 8-segmented with pseudo-articulation on fourth segment (Fig. 8 J), 0.28-0.29 mm long. Spiracles normal. Legs well developed with a tibio-tarsal articulatory sclerosis and without free articulation. Claw simple, digitules much longer than claw and flattened apically; tarsal digitules long and slender with clubbed apices (Fig. 8 K); dimensions of fore, mid and hind legs : trochanter + femur (0.16 : 0.17: 0.17 mm), tibia (0.12 : 0.12: 0.13 mm) and tarsus (0.07 : 0.08: 0.09 mm) respectively.

Material examined: 1 slide with single adult female, labelled: *Lecanium ophiorrhizae* Green, from *Ophiorrhiza pectinata*, Pundaluoya, Ceylon (Co-type) (BMNH).

The general appearance of this species as given in original description is "Oblong, pointed in front. Pale fulvous with dark reddish, reticulated pattern" (Green 1896).

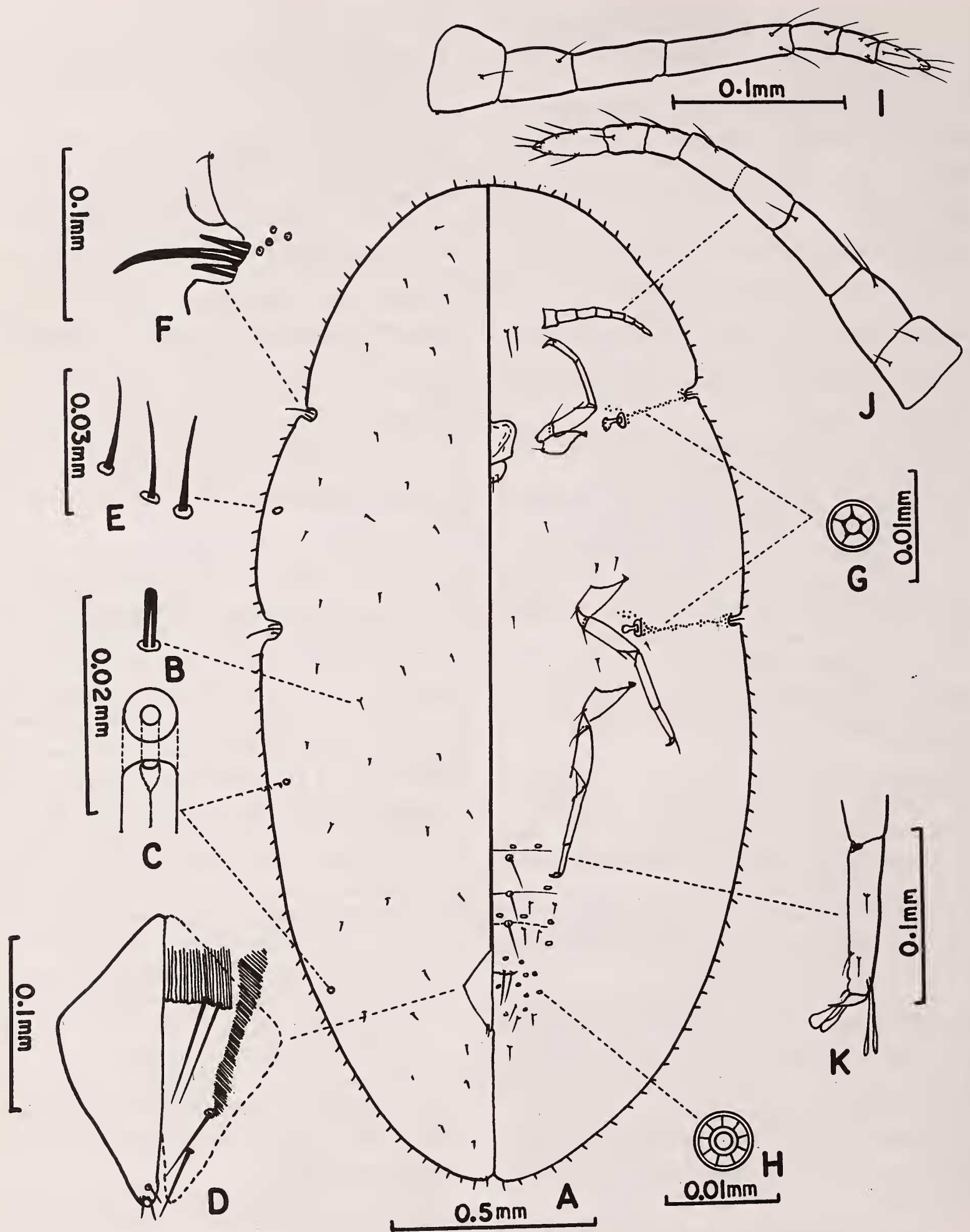


Fig. 8. *Coccus ophiorrhizae* (Green), female. See text for explanations.

Distribution: Andhra Pradesh: Kurnool (Ayyar 1930).

Coccus ramakrishnai (Green)

Lecanium ramakrishnai Green in Ayyar 1930: 47.
Coccus ramakrishnai (Green): Varshney 1985: 26.

Green in Ayyar (1930) recorded this species from Kothapetta (Godavary district) and described it as "The adult scales have a bluish black colour, and in shape the scale is more or less conical. The young insects are of a pale yellowish brown colour". Recently, Varshney (1985) listed it as a valid species in the genus *Coccus*. We were not able to trace further references to this species except those listed above, or material for study. The available description is inadequate and therefore the species is not included in the key and the status of the species is only provisionally accepted here.

Coccus viridis (Green) (Fig. 9)

Lecanium viridis Green 1886: 1-4; Fletcher 1919: 294; Ayyar 1930: 49.

Coccus viridis (Green): Fernald 1903: 174; Zimmerman 1948: 311; De Lotto 1959: 172; 1960: 397; Das and Ganguli 1961: 248; Ali 1971: 28; Gill *et al.* 1977: 37; Varshney 1985: 26; Avasthi and Shafee 1988: 44.

Adult female (Fig. 9 A): Mounted specimens oval to elongate oval, 2.38-2.71 mm long, 1.32-1.6 mm wide. Dorsal setae (Fig. 9 B) small, cylindrical, slightly swollen apically and sparsely distributed. Submarginal tubercles (Fig. 9 C) 9-11 in number. Para-opercular pores absent. Anal plates (Fig. 9 E) together quadrate, about as long as their combined width, each plate with three apical and two subapical setae; anal fold with two pairs of fringe setae. Marginal setae (Fig. 9 F) short, bifid and fimbriate apically, 7-10 setae between anterior and posterior stigmatic clefts. Stigmatic clefts well developed, each with 3 spines; median spine about twice the length of laterals (Fig. 9 G).

Venter with thin spinose setae, irregularly distributed. Inter-antennal and prevulvular setae 2-3 and 3 pairs respectively. Quinquelocular pores

(Fig. 9 I) few, arranged in a row between cleft and spiracles. Multilocular pores (Fig. 9 J) present around genital opening and a few present on all abdominal segments. Tubular ducts (Fig. 9 H) present in bands on mid thoracic regions, a few near forelegs. Eyes absent. Antennae (Fig. 9 K) 7-segmented, 0.22-0.25 mm in length. Spiracles normal. Legs well developed, with tibio-tarsal articulatory sclerosis; claws simple, digitules longer than claw and clubbed at apices (Fig. 9 L); dimensions of fore, mid and hind legs: trochanter + femur (0.12-0.14: 0.14-0.15: 0.14-0.15 mm), tibia (0.09-0.1: 0.09-0.11: 0.09-0.1 mm), and tarsus (0.04-0.05: 0.04-0.05: 0.04-0.05 mm) respectively.

Material examined: 1 slide with 9 adult females labelled: *Lecanium viride* Green, from Coffee, Baudaravella, Ceylon (BMNH). 3 females, INDIA: Andhra Pradesh, Masulipatam, Kondapalle, on wild plant, 13 April 1979 (R.K. Avasthi) (ZMAMU).

Distribution: Assam: Tocklai; Karnataka: Mysore, Bangalore; Andhra Pradesh: Masulipatam.

Coccus wattii (Green)

Lecanium wattii Green 1900: 6.

Coccus wattii (Green): Fernald 1903: 174; Rao and Kumar 1952: 3; Varshney 1985: 26.

Saissetia wattii (Green): Das and Ganguli 1961: 247; Ali 1971: 45.

This species is redescribed and illustrated in detail by Rao and Kumar (1952).

Distribution: West Bengal; Assam.

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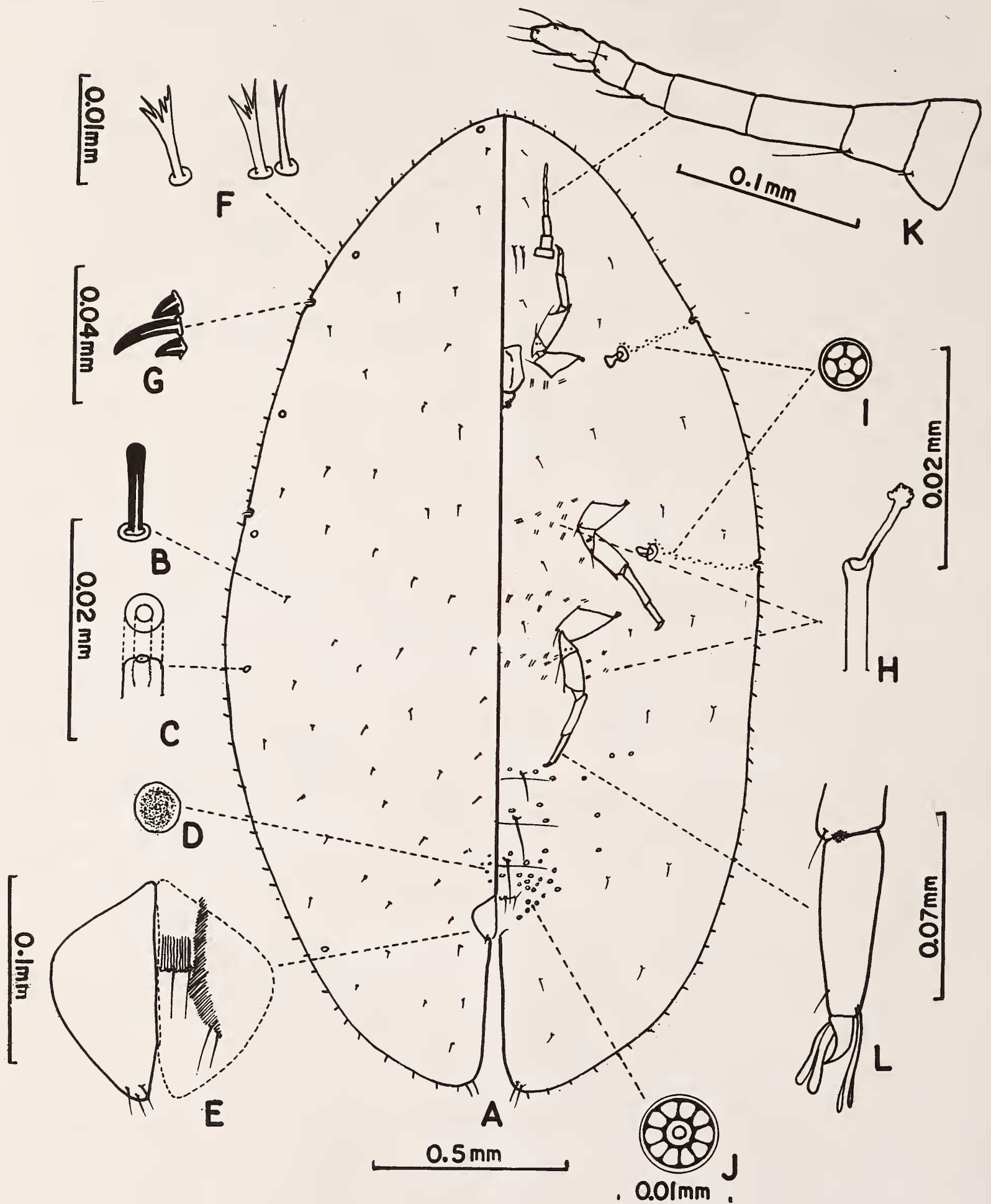


Fig. 9. *Coccus viridis* (Green), female. See text for explanations.

REFERENCES

- ALI, S. M. (1971): A catalogue of the Oriental Coccoidea. part V. *Indian Mus. Bull.* VI (2): 7-82.
- AVASTHI, R.K. & SHAFEE, S.A. (1983): Two new species of *Coccus* Linn. (Homoptera: Coccidae) from India. *Verh. SIEEC X. Budapest*, 389-392.
- AVASTHI, R.K. & SHAFEE, S.A. (1988): Record of some Indian species of *Coccus* Linn. (Homoptera : Coccoidea). *Bull. Pure & Appl. Sci.* 7A (1-2): 42-44.
- AYYAR, T.V.R. (1930): A contribution to our knowledge of South Indian Coccidae (Scales & Mealybugs). *Agr. Res. Inst. Pusa, Bul.* 197 (1929): 73.
- BEN-DOV, Y. (1977): Taxonomy of the long brown scale *Coccus longulus* (Douglas), stat. n. (Homoptera : Coccidae). *Bull. ent. Res.* 67: 89-95.
- BEN-DOV, Y. (1981): A new species of *Coccus* (Homoptera : Coccidae) from mango in Israel and a redescription of *C. gymnospori* (Green). *Bull. ent. Res.*, 71: 649-654.
- BOISDUVAL, A.M. (1867): Essai sur l'entomologie horticole. *Paris, Donnaud* 648 pp. (300-358).
- BORATYNSKI, K. & WILLIAMS, D.J. (1964): A note on some British Coccoidea, with new additions to the British Fauna. *Roy. Ent. Soc. London., Proc. Ser. B: Taxonomy*, 33: 103-110.
- BORCHSENIUS, N.S. (1957): Fauna of U.S.S.R., Homoptera, Coccidae (In Russian). *Akad. Nauk Zool. Inst. (n.s.)* 66: 9.
- BRAIN, C.K. (1920): Coccidae of South Africa-V. *Bull. Ent. Res.* 11: 1-41.
- BURMEISTER, H. (1835): Scharlachlaus. Schildlaus. Coccina (Gallinsecta L.) *In Handb. der Ent.* v. 2. abt. 1. pp. 61-83.
- COCKERELL, T.D.A. (1893a): Notes on *Lecanium*, with a list of the West Indian Species. *Amer. Ent. Soc. Trans.* 20: 49-56.
- COCKERELL, T.D.A. (1893b): A list of West Indian Coccidae. *Inst. Jamaica Jour.* 1: 252-256.
- COCKERELL, T.D.A. (1896): Preliminary diagnosis of new Coccidae. *Psyche*, 7 (1894-1896) (supl.): 18-21.
- COCKERELL, T.D.A. (1897): Notes on new Coccidae. 1. A new coccid pest of greenhouses. 2. A Japanese coccid quarantined at San Francisco. *Psyche*, 8: 52-53.
- COSTA, O.G. (1828): Prospetto di una nuova divisione metodica del genere *Coccus* Linn. *Lam. EC. Napoli*, Dalla Tipografia Trani, 8 pp.
- COSTA, O.G. (1835): Fauna del regno di Napoli, Famiglia de' Coccinigliiferi, o de' gallinsetti. *Emitteri Napoli* 23 p.
- CURTIS, J. (1843): *Coccus patellaeformis* (Curtis): The brown Limpet-scale. *Gard. Chron. No.* 30: 517-518.
- DANZIG, E.M. & KERZHNER, I.M. (1981): *Coccus* Linn., 1758 and *Parthenolecanium* Sulc, 1908 (Insecta, Homoptera, Coccidae): proposed designation of type-species under the plenary powers. *ZN(S)* 2125. *Bull. Zool. Nomencl.* 38 (2): 147-152.
- DAS, G.M. (1959): Observations on the association of ants with tea coccids. *Bull. ent. Res.* 50(3): 437-448.
- DAS, G.M. & GANGULI, R.N. (1961): Coccids on tea in North East India. *Indian Jour. Ent.* 23: 245-256.
- DE LOTTO, G. (1957): On some Ethiopian species of the genus *Coccus* (Homoptera: Coccoidea : Coccidae). *Ent. Soc. South Africa Jour.* 20: 295-314.
- DE LOTTO, G. (1959): Further notes on Ethiopian species of the genus *Coccus* (Homoptera: Coccoidea: Coccidae). *Ent. Soc. South Africa Jour.* 22: 150-173.
- DE LOTTO, G. (1960): The green scale of coffee in Africa South of the Sahara (Homoptera : Coccidae). *Bull. Ent. Res.* 51: 389-403.
- DE LOTTO, G. (1965): On some Coccidae (Homoptera), chiefly from Africa. *Brit. Mus. (Nat. Hist.) Ent. Bul.*, 16: 175-239.
- DOUGLAS, J.W. (1886): Note on some British Coccidae (No. 4) *Ent. Monthly Mag.* 23: 77-82.
- DOUGLAS, J.W. (1887a): Note on some British Coccidae (No. 7). *Ent. Monthly Mag.* 24: 21-28.
- DOUGLAS, J.W. (1887b): Notes on some British Coccidae (No. 8). *Ent. Monthly Mag.* 24: 95-101.
- EHRHORN, E.M. (1898): New Coccidae. *Canad. Ent.* 30: 244-246.
- FERNALD, M.E. (1903): A catalogue of the Coccidae of the World. *Mass Agr. Expt. Sta. Spec. Bul.* 88: 360 pp.
- FERRIS, G.F. (1921): Some Coccidae from Eastern Asia. *Bull. Ent. Res.* 12: 211-220.
- FERRIS, G.F. (1936): Contribution to the knowledge of the Coccoidea (Homoptera). (Contribution No. 1). *Microentomology*, 1: 1-16.
- FLETCHER, T.B. (1919): Annotated list of Indian Crop-pests. *Ent. Mtg., 3, Pusa, Rpt. Proc.* 1: 33-314 (286-304).
- FLETCHER, T.B. (1921): Additions and corrections to the list of Indian crop-pests. *Ent. Mtg. 4, Pusa, Rpt. Proc.*, pp. 14-20 (18-20).
- GANGULI, R.N. & GHOSE, M.R. (1964): Coccids of Tripura. *Indian Jour. Ent.*, 26: 358-359.
- GENNADIUS, P. (1895): Sur deux cochenilles du caroubier dans l'île de chypre (Hem.). *Soc. Ent. de France Ann. (Bul des Seances)* 64: cclxxvii.
- GEOFFROY, E.L. (1762): Histoire abregee les insectes qui se trouvent aux environs de Paris, v. 1. pp. 498-513.
- GHOSE, S.K. (1961): Studies on some coccids (Coccoidea : Hemiptera) of economic importance of West Bengal, India. *Indian Agr.* 5(1): 57-78.
- GILL, R.J., NAKAHARA, S. & WILLIAMS, M.L. (1977): A review of the genus *Coccus* Linnaeus in America North of Panama (Homoptera : Coccoidea: Coccidae), State of California. *Dept. Food & Agriculture Div. Plant Industry-Laboratory Service*, No. 24: 1-44.

- GREEN, E.E. (1886): Observations on the green scale bug in connection with the cultivation of coffee. *Entom. Pundaluoya*, 4p.
- GREEN, E.E. (1896): Catalogue of Coccidae collected in Ceylon. *Indian Mus. Notes* 4 (1896-1900): 2-10.
- GREEN, E.E. (1900): Remarks on Indian scale insects (Coccidae), with descriptions of new species. pt. I. *Indian Mus. Notes* 5: 1-13.
- GREEN, E.E. (1904): The Coccidae of Ceylon. pt. III. London Dulau. pp. 171-249.
- GREEN, E.E. (1908): Remarks on Indian scale insects (Coccidae) part III with a catalogue of all species hitherto recorded from the Indian continent. *India Dept. Agr. Mem., Ent. Ser.* 2: 15-46.
- GREEN, E.E. (1918): Some remarks on Mr Kunhi Kannan's paper, 'An instance of mutation'. *Ent. Soc. London, Trans.* 1918: 149-154.
- GREEN, E.E. (1922): Supplementary notes on the Coccidae of Ceylon, part IV. *J. Bombay Nat. Hist. Soc.* 28: 1007-1037.
- GREEN, E.E. (1937): An annotated list of the Coccidae of Ceylon, with emendations and addition to date. *Ceylon Jour. Sci., Sect. B., Zool. and Geol. Spolia Zeylanica* 20: 277-341.
- HODGSON, C.J. (1967): Notes on Rhodesian Coccidae (Homoptera: Coccoidea) Part I. The genera *Coccus*, *Parasaissetia*, *Saissetia* and a new genus *Mashona*. *Arnoldia (Rhodesia)* 3(5): 1-22.
- KANNAN, K.K. (1918): An instance of mutation: *Coccus viridis*, Green, a mutant from *Pulvinaria psidii* Maskell. *Ent. Soc. London, Trans.* 1918: 130-148.
- KIRKALDY, G.W. (1902): Hemiptera. *Fauna Hawaiiensis* 3: 93-174 (102-112).
- KUWANA, I. (1902): Coccidae from the Galapagos Islands. *N.Y. Ent. Soc. Jour.* 10: 28-33.
- KUWANA, I. (1909): Coccidae of Japan (IV). A list of Coccidae from the Bonin Islands (Ogasawarajima), Japan. *N.Y. Ent. Soc. Jour.* 17: 158-164.
- LINDINGER, L. (1928): Bericht Uber die Tatigkeit der abteilung fur pflanzenschutz. A. *Hamburg. Inst. f. Angew. Bot. Jahresber.* 1924/26: 94-110 (94-107).
- LINNAEUS, C. (1758): Insecta, Hemiptera. *Coccus. Systema Nat.* (Ed. 10) 1: 455-457.
- MAMET, R. (1936): New species of Coccidae (Homopt., Homopt.) from Mauritius. *Roy. Ent. Soc., London, Proc. Ser. B: Taxonomy* 5: 90-96.
- MASKELL, W.M. (1890): Further notes on Coccidae, with descriptions of new species from Australia, Fiji and New Zealand. *New Zeal. Inst. Trans. and Proc.* 22 (1889): 133-156.
- MASKELL, W.M. (1897a): Further coccid notes: with descriptions of new species and discussions of points of interest. *New Zeal. Inst. Trans. and Proc.* 29 (1896): 293-331.
- MASKELL, W.M. (1897b): On a collection of Coccidae, principally from China and Japan. *Ent. Monthly Mag.* 33: 239-244.
- MISRA, C.S. (1924): A list of Coccidae in the Pusa collection. *Ent. Mtg. (Pusa, 1923) Proc.* 5: 345-351.
- MORRISON, H. (1921): Some nondiaspine Coccidae from the Malay Peninsula, with descriptions of apparently new species. *Philippine Jour. Sci.* 18: 637-677.
- NEWSTEAD, R. (1892): On new or little known coccidae, chiefly English (No. 2). *Ent. Monthly Mag.* 28: 141-147.
- NEWSTEAD, R. (1903): Monograph of the coccidae of the British Isles, v. 2 (1902): *London, Roy. Society*, 270 p.
- NEWSTEAD, R. (1917): Observations on scale-insects (Coccidae) - III. *Bull. Ent. Res.* 7: 343-380.
- PUTTARUDRIAH, M., & CHANNABASAVANNA, G.P. (1953): Occurrence of *Coccus viridis* (Green) and *Coccus viridis colemani* Kannan, in South India. *Indian Coffee* 17: 248-253.
- RAO, V.P. & KUMAR, H.K. (1952): Little known or hitherto unrecorded species of coccids from the Indian region. *Indian Jour. Ent.* 14: 1-10.
- SANDERS, J.G. (1909): Catalogue of recently described coccidae - II. *U.S. Dept. Agr. Bur. Ent. Tech. Ser.* 16: 33-60.
- SIGNORET, V. (1873): Essai sur les cochenilles ou gallinsectes (Homoptera: Coccides). *Soc. Ent. de France Ann.* (Ser. 5). 3: 395-400.
- TAKAGI, S. (1975): Coccoidea collected by the Hokkaido University expedition to Nepal Himalayas, 1968 (Homoptera). *Insecta Matsumurana* No. 6: 1-33.
- TAKAHASHI, R. (1952): Some species of nondiaspine scale insects from the Malay Peninsula. *Insecta Matsumurana* 18 (1/2): 9-17.
- TARGIONI-TOZZETTI, A. (1891): Cocciniglie degli agrumi in italia specialmente in sicilia. Secndo le notizie raccolte, le osservazioni e le esperienze. *R. Staz. di Ent. Agri. di Firenze.* 32 p.
- VARSHNEY, R.K. (1985): A review of Indian Coccids (Homoptera, Coccoidea). *Oriental Insects* 19: 1-101.
- WILLIAMS, M.L. & KOSZTARAB, M. (1972): Insects of Virginia no. 5 Morphology and systematics of the Coccidae of Virginia, with notes on their biology (Homoptera: Coccoidea). *Va Polytech. Inst. State Univ. Res. Div. Bull.* 52: 215 p.
- ZIMMERMAN, E.C. (1948): Insects of Hawaii, vol. 5. Homoptera: Sternorhyncha. Honolulu, Univ. of Hawaii Press. pp. 132-436.